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ROYAL AIRCRAFT ESTABLISHMENT

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Library Translation 2072

November 1981

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**SWEDISH DEFENCE RESEARCH
ABSTRACTS 1980/81-3**

by

National Defence Research Institute, Stockholm

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Procurement Executive, Ministry of Defence
Farnborough, Hants

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SWEDISH DEFENCE RESEARCH ABSTRACTS 1980/81-3

[FRÖ FORSVARS FORSKNINGS REFERAT 1980/81-3]

by

National Defence Research Institute, Stockholm

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EDITOR'S SUMMARY

The Swedish National Defence Research Institute issues a quarterly list of unclassified Reports published by the Institute. The titles of these Reports and informative abstracts have been translated in English. This volume is the third issue of 1980/81. Further volumes will be translated in due course. The main topics covered are: Protection - atomic, biological, chemical; ammunition and weapons; conduct of war, information and commands; vehicles and spacecraft; reliability and logistics; human factors; associated studies and their solutions; positive methods for limitation and control of armaments; psychology reports.

EDITOR'S NOTE

The Reports are in Swedish unless some other language is indicated (usually English). When requesting Reports it should be appreciated that an English version will not normally be available, and that the prices of the original Swedish documents have not been indicated in this Translation. Reports may be obtained from:

FOA Centrelkansliet, S-104 50 Stockholm, Sweden



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A PROTECTION - ATOMICA1 The nuclear weapon threat

(112) FOA report A40032-A1 (A3)

The consequences of, and measures to combat, major leakages of radioactive material from Swedish nuclear power stations in an emergency and in wartime

Robert Fink and others

February 1980

Since 1976 at the instance of the Civil Defence Authority, the Institute of Defence Research has been conducting a study programme to evaluate the dangers of radioactive and chemical materials to the community during an emergency and in wartime (the TOX study). This report presents the results gained so far concerning the serious consequences of major leakages of radioactive materials from Swedish nuclear power stations and measures to combat them. The probability of a leakage is considered to be greater in wartime than in peacetime, although international agreements impose restrictions on the choice of nuclear power stations as military targets.

Calculations show that unprotected humans in the vicinity of a nuclear power station can receive severe injuries should any large quantities of radioactive material leak out as a result of hostilities against power stations. The danger zones and any modification to them due to various protective measures have been calculated for the most serious case of damage which can be felt likely to affect Swedish installations. At short ranges serious lung damage may occur through the inhalation of radioactive dust. The presence of individuals in the region of high radioactive fall-out may in some cases produce fatal injuries.

During emergencies and in wartime the facilities for protection are in general better than in peacetime, and any protective measures taken promptly, such as the use of face masks and withdrawal to radiation-proofed premises, will greatly reduce the extent of damage. The best protection is obtained in shelters equipped with good aerosol filters combined with carbon filters, although even refuge in stone-built houses or cellars will contribute substantially to containing the extent of radiation injury. Evacuation will cut down the amount of injury. The consumption of potassium iodide tablets reduces the intake of radioactive iodine into the thyroid gland, which reduces the risk of functional changes.

The results were submitted to a study meeting in 1979 in the form of a seminar. Also discussed during this meeting were the direction of future research and what further information was required for evaluating the consequences of a leakage of radioactive material during an emergency and in wartime, and what were the suitable countermeasures. Action on the production of further information is currently in progress in cooperation with the Institute of Defence Research, the Civil Defence Authority and the National Institute of Radiation Protection.

A3 Effects of nuclear explosions, and protective measures

(113) FOA report C20402-A3

Anti-radiation calculations for residual radiation in some residential blocks
Göran Danielson

March 1981

The report presents the anti-radiation calculations for residual radiation carried out on different floors in various residential blocks. The numerical protective

factors formed the basis of Radiak 78. Some values have also been used in the TOX study.

The calculations on small dwellings cover some simple examples of single- and two-storey houses, both with and without cellars. The report demonstrates that for the floors in such small dwellings the protection factor 0.4 can be used for timber houses and 0.2 for houses of brick and light concrete sections.

Three six-store blocks were selected as examples of multi-occupation housing. Calculations are given for two points on each storey, and for four alternative levels of fall-out. The protective factors are calculated to fall in the interval of 0.01 to 0.2.

(114) FOA report C40120-A3
The simulation of a fall-out radiation zone
Göran Hultén and others

August 1980

The training of anti-radiation personnel calls for exercises in which areas of radioactive fall-out can be simulated. This is usually done by simulating a reading on the intensimeters being employed. There are different ways of doing this depending on the degree of realism in the exercise. The present report describes various systems of fall-out simulation and also describes a prototype simulator based on the type 21 intensimeter. This simulator is time-controlled, and it can be built-in to the intensimeter as an extra circuit board. This board constitutes a control unit with stored information which generates a current which varies over time.

Various zones of radioactive fall-out can be simulated by changing a semiconductor memory. A modified intensimeter can be used continuously to measure radioactive radiation.

The cost of the components at present amounts to about SKr 200.

(115) FOA report C40122-A3
The geographical distribution of population around Swedish nuclear power stations
Gunnar Bergquist and Robert Fink

October 1980

The geographical distribution of population within a 12 mile radius about Swedish nuclear power stations at Barsebäck, Ringhals, Oskarshamn and Forsmark has been listed in tables and diagrams. The population data reported here are stored in computer-readable form, and are used for calculating population doses for various types of uncontrolled leakage of radioactive materials.

(116) FOA report C40125-A3
The neutron bomb. The need for detection
Göran Hultén and Lennart Johansson

July 1980

The introduction of low-power tactical nuclear weapons has revived the need for the detection of various radiation components. Since neutrons constitute a substantial portion of the primary radiation emitted, a need for special neutron detection facilities may exist.

Nuclear weapons of increased radiation yield have been discussed in recent years. These weapons are frequently termed neutron bombs. Investigation of the damage pattern from 1-10 kn neutron bombs shows that the area in which the radiation alone inflicts acute radiation damage, whereas the effect of the thermal radiation and the shock wave are of lesser importance from the aspect of survival, is confined to a circle of a few hundred

metres radius. In this area about 50% of the total dose derives from neutrons. The biological effect of neutrons for acute injury is almost 1, according to what is known at present.

The current method of multiplying the gamma dose in the initial radiation by two to obtain the total dose is also applicable to these hypothetical neutron weapons. There is therefore no immediate occasion to introduce neutron detection into the defence system. Neutron detection however can be allowed for by conversion of the instrumentation in stock. For this purpose what are known as 'charge-transfer' chambers and biological dosimetry represent some interesting principles of detection. The report provides a summary of the more important methods of detection at present known.

A4

- (117) FOA report B40123-A4
DNA repair and frequency of X-ray and uv-light induced chromosome aberrations in leucocytes from patients with Down's syndrome (in English)
B. Lambert and others March 1981

The uv-light induced synthesis of DNA repair was measured by incorporating [^3H] thymidine in the presence of hydroxyurea. Dose-response curves were measured for leucocytes from individuals with Down's syndrome and from normal individuals. The cells from patients with Down's syndrome incorporated 70-75% of the activity in the control cells for the different doses (32-196 erg/mm²). This difference was significant for the two highest uv doses ($P < 0.01$). After X-ray irradiation (150 rad) the frequency of dicentric chromosomes was 35% greater in Down's syndrome leucocytes than in the control cells ($P < 0.001$).

Combined irradiation with uv and X-rays produced a doubling in the frequency of dicentric chromosomes in the control cells, while the increase was only 27% in Down's syndrome leucocytes. This synergistic effect between uv and X-ray irradiation as regards the frequency of dicentric chromosomes indicates that the healing of DNA injuries induced by X-rays and uv light can partly exploit the same repair enzyme.

The results also indicate that the mechanisms of DNA repair are impaired in leucocytes from patients with Down's syndrome, and that this may contribute to the increased incidence of leukaemia and sensitivity to X-ray exposure in this illness.

FOA reprints 1980/81:35.

- (118) FOA report B40124-A4
Lack of synergistic effect between X-ray and UV irradiation on the frequency of chromosome aberrations in PHA-stimulated human lymphocytes in the G_1 stage (in English)
M. Holmberg March 1981

PHA-stimulated human lymphocytes in the G_1 stage were exposed to uv-light and X-rays and the cells were analysed in the first mitotic division for chromosome aberrations. The frequency of dicentric chromosomes after exposure to X-rays alone in the G_1 stage was about twice that in the G_0 stage. No increase in the frequency of dicentric chromosomes was observed after combined exposure to uv-light and X-rays. This is in contrast to observations for G_0 lymphocytes, where a twofold increase in chromosome aberrations was observed.

Uv irradiation of G_1 lymphocytes induced chromatid-type aberrations, whereas no significant yield of dicentric chromosomes was observed. This is in agreement with previous observations in Chinese hamster cells in the G_1 stage⁷. Irradiation of G_0

lymphocytes with uv-light induces a low frequency of dicentric chromosomes. The present results therefore indicate that the ratio between chromosome-type and chromatid-type aberrations are different in the G_1 and G_0 stages in human lymphocytes when irradiated by uv-light.

FOA reprints 1980/81:36

B PROTECTION - BIOLOGICAL

B1 Threat scenario

(119) FOA report C40095-B1

Epidemiological aspects of protection from biological weapons
Ingrid Bölin and Hans Erik Carlsson

January 1979

The occurrence of epidemics in wartime is favoured by the deterioration of hygienic standards, *eg* in billeting after evacuation and under field conditions. This may render it difficult to investigate and combat epidemics. In the devising and planning of protection from biological weapons it should therefore be useful to appreciate the sequence of events in epidemics and the measures which can be taken to prevent the further spread of an epidemic. An attack with secondarily infectious biological weapons may be assumed to a large extent to resemble epidemics which occur naturally. When evaluating the way in which biological protection affects the usefulness of such weapons, one should also take into account the epidemiological aspects and the risk of reservoirs of infectious substances.

The present report is submitted as information for evaluating the epidemiological aspects of protection against biological weapons. This report represents a contribution in the activities of 'B Group' for the research task set by the F&D to the FOA concerning the techniques, doctrine and warfare in the future (ABC warfare). It affords comprehensive guidance on the organisation of the control of epidemics. The most important measures for limiting epidemics have been listed and roughly evaluated with respect to protection from biological weapons. The ways in which protection from biological weapons may affect the usefulness of such weapons is also discussed.

(120) FOA report C40131-B1

A survey of apparatus and methods for the sampling and analysis of airborne microorganisms
Eva Henningson

March 1981

The apparatus generally available for sampling living airborne microorganisms is described, examined and compared in this report. Each apparatus has been described in detail, partly as regards its technical aspects and field of application in order to assist the choice of apparatus for measurement in a given environment. Some examples are provided of how a microbiological investigation of airborne microorganisms should be performed, including recommendations of media for various types of microorganism. A comparison of the different items of apparatus is drawn in order to describe roughly their suitability for sampling in different environments, and in order to assess roughly their collecting efficiency one with another. The need for research in this field is briefly dealt with. The report, which was produced at the instance of the Committee on Industrial Safety, is intended to form the basis for a further collection of facts and

opinions on this subject, so that any comments, experience and views on the sampling and analysis of airborne microorganisms will be received with interest by Branch 440 of the FOA.

B2 Protective measures

- (121) FOA report A40033-B2
The development of luminescence analysis at the FOA during financial years 1967/68 to 1979/80. A review
Anders Thore and Thomas Olsson June 1980

A project for developing chemical methods of analysis for the rapid indication of bacterial aerosols was begun at the FOA in the financial year 1967/68. A project, which involved principally methods based on reactions in chemiluminescence, was expanded during the elapsed period to include also a number of medical applications variously oriented to military purposes. For certain parts of this activity support was obtained from the Committee on Technical Development. Up to 1979/80 inclusive the project has turned over altogether about SKr 7.5 m, of which about 5.8 m from the FOA budget. The results achieved and experience gained have been continually reported in the form of scientific articles and technical accounts. The total of about 80 reports cover among other things reviews of techniques and the study of methods including techniques of analysis in microbiology and biochemistry. This documentation is summarised and discussed in the present report.

- (122) FOA report C40109-B2
Recording methods in the measurement of luminescence light with photomultipliers
Göran Hultén and Hans-Göran Larsson March 1980

Four photomultipliers (2 EMI 9781R, 1 EMI 9757B and 1 RCA 1P21) were exposed to light emanating from bioluminescence reactions and from a radioactive light source. The signals were recorded both as an analogue current (filtering) and also by calculating the number of pulses per unit time (photon counting). By photon counting it was possible to observe an increase in the signal-to-background noise ratio and the signal-to-background ratio by a factor of 1.5. An EMI 9757B has a sensitivity superior to that of the RCA 1P21 tube by a factor of 100.

- (123) FOA report C40112-B2
Testing of a bacterial aerosol detector based on chemiluminescence analysis
Gunilla Eriksson and others April 1980

Equipment was tested for the laboratory detection of bacterial aerosols based on the measurement of luminol-based and haematin-induced luminescence. The measured luminescence is directly proportional to the bacteria concentration for aerosols with a density of about $10^6 - 10^8$ bacteria/m³. In model experiments with non-aerosolised bacteria, a lowest theoretically detectable bacteria content was obtained of about 10^5 bacteria/m³.

In order to achieve the desired sensitivity of about 10^4 bacteria/m³ and the development of a prototype for sampling in the field, one or more of the following measures is necessary:

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- increasing the efficiency and capacity of the aerosol sampler,
- increasing the amplitude of the light emission by modifying the mixing ratio in the reactor,
- choosing a photomultiplier with less thermoelectric noise.

(124) FOA report C40117-B2
Principles of luminescence analysis of flavin mononucleotide and pyridin nucleotides with bacteria luciferase: a review of literature
Thomas Olsson and Anders Thore June 1980

The bacteria luciferase system can be used to give a sensitive analysis (10^{-13} - 10^{-16} mol) of flavin mononucleotide (FMN) and pyridin nucleotides (NAD, NADP). The principle of analysis also includes determining a substrate and enzyme which can be linked to the reduction or oxidation of pyridin nucleotides.

In commercially available preparations of luciferase, sensitivity is limited by endogenous nucleotides and enzymes which convert NAD(P). Other limiting factors are the auto-oxidation of FMNH₂ which leads to a rapid consumption of the substrate, an unfavourable time-curve for the light emission and an instability of the long-chain aliphatic aldehydes which are involved in the reaction.

B3 Injuries and treatment - biological

(125) FOA report B40122-B3
Ingestion of Yersinia pseudotuberculosis into human fibroblasts in vitro
Gustaf Brunius and others (in English) March 1981

The authors investigated the ingestion of various strains of Yersinia pseudotuberculosis (virulent and non-virulent) into fibroblast cultures. The kinetics of ingestion were studied by adding 10^7 bacteria to in vitro cultures of human lung fibroblasts. This was followed by determining the number of living bacteria ingested after 0.5 to 3 hours. All the strains were ingested apart from one non-virulent strain. The other strains were ingested by the cells at about the same rate. Ingestion appeared to take place by a process resembling phagocytosis, and the intracellular bacteria were recovered in vacuoles. The bacteria survived and multiplied within the cells (for up to 7 days).

Offprint from Scand. J. Infect. Dis., Suppl. 24:162-164, 1980;

FOA reprints 1980/81:34.

(126) FOA report C40115-B3
Determination of cellular ATP in cow's milk by luminescence for the screening of mastitis
Thomas Olsson and others June 1980

For purposes of investigating the possibility of using the determination of cellular ATP in cow's milk as a rapid diagnostic test for mastitis, the conditions for such an analysis were studied with an ATP-specific luminescence reaction using firefly luciferase.

A simplified method for extracting ATP from somatic cells (lymphocytes) was devised and was evaluated with respect to the yield of ATP and its compatibility with luciferase analysis. This simplified method was tested both in a model system based on standard or whole milk with the addition of lymphocytes, and in actual milk samples with a varying cell count.

Proportionality and correlation between the cell count and ATP in the model system were good, and the method proved feasible over the relevant cell-count interval. Bacterial ATP did not interfere in this system.

Further studies of the usefulness of the method for the screening of mastitis will be directed towards optimising the methods of extraction and analysis in an enlarged and well-characterised range of milk, with special respect to the stability of the samples and extracts, and towards examining the usefulness of it in a practical routine.

- (127) FOA report C40116-B3
Principles of luminescence analysis of immunological reactions (immuno-luminescence) - review of the literature
Thomas Olsson and Anders Thore June 1980

Luminescence reactions have been used and described in the literature as a sensitive indicator of antigen/antibody reactions in immuno-analytical systems based on luminescence reactions. Luminescence analysis can be used in principle for immuno-analytical applications on the lines of the generally adopted methods of enzyme- or radio-immunology, *eg* solid phase assay, double antibody precipitation or homogeneous assay.

The use of luminescence analysis in these systems is illustrated and discussed in the present report.

- (128) FOA report C40118-B3
The results of microbiological air sampling at a composting plant
Per Ånäs and Lars Brynolf July 1980

The results are reported from five microbiological air samples taken at different places in a composting plant. The air was analysed for the following types of microorganism:

Total number of bacteria (culture temp 24°, 37° and 50°C); total number of fungi (culture temp 24° and 44°C); coliform bacteria (culture temp 37° and 44°C); salmonella; thermophilic actinomycetes (culture temp 50°C); the size of airborne particles containing bacteria and fungi respectively.

The results obtained in the great majority of cases were normal for this type of working environment.

Apart from those microorganisms which directly cause disease, there is only an imperfect knowledge of the dangers to health which may be caused by airborne microorganisms. No standards can therefore be stated as to limiting hygienic values etc, although extended investigations into this field are of great interest.

C PROTECTION - CHEMICAL

C1 Threat scenario

- (129) FOA report C40132-C1 (b1)
A data-collecting system for a meteorological measuring station at FOA 4 in Umeå
Staffan Löf and others March 1981

The report describes a data-collection system, DAMM (Data-collection system for a Meteorological Measuring station), which was developed for collecting and storing data from the meteorological measuring station at FOA 4 in Umeå. The system collects data on wind conditions, temperatures, precipitation, atmospheric humidity, radiation etc.

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The data are collected by means of a measuring system consisting of a transmitter mounted on a mast and coupled to a local micro-computer. The collected data are transmitted over a fixed circuit to the central computer in FOA 4, a VAX-11/780, where they are corrected and stored in a database. The database when thus generated can function as a source of information which can be supplied as a basis for simulation models and various types of analytical program etc.

The work was performed as an independent secondary study under the project, Field Measurements and Models of Atmospheric Propagation.

C2 Projective measures

(130) FOA report A40034-C2 (A2, B2)

The effects of beards, stubble and old-age wrinkles on the fitting of respirators

Per-Gunnar Jönsson

November 1980

Beards and stubble can be expected to detract from the good fitting of respirators. For the purpose of investigating the extent to which this is so, the amount of leakage past eight different types of respirator was measured on 31 male test subjects. Measurements were taken first on newly-shaven subjects, and were repeated after the beards had been allowed to grow for 8, 24 48 and 96 hours. Two half-masks, four full-masks and two compressed-air masks were investigated. In three of the masks a noticeable impairment of fit was measured even after 8 hours' growth of beard.

The same eight respirators were test-fitted also on 20 subjects with full-beards. None of the respirators tested afforded satisfactory protection.

Besides beards and other growths of hair, wrinkled skin may also detract from a good fit. The effect of this factor on good fitting was investigated by measurements on 56 pensioners. One half-mask and four different full-masks were used for this. The tightness of fit throughout was considerably worse than when the respective masks were tested out on a younger panel.

(131) FOA report C40107-C2

Conference on insulation films on semiconductors INFOS 79, 2-4 July 1979, Durham, UK. A visit report
Göran Hultén and Per Fällman

December 1979

The report covers a visit to the UK by Res. Off. 1 Göran Hultén and Res. Eng. Per Fällman during 2-4 July 1979.

It consists mainly of gists of lectures dealing with firstly some measuring methods in use for the analysis of thin films and secondly with the results and their interpretation from electrical and optical measurements of thin insulated layers principally of silicon dioxide.

(132) FOA report C40110-C2

Data logger with a MNOS memory
Göran Hultén and others

March 1980

A data logger with a wide range of applications at extremely low temperatures has been produced and tested for accuracy etc. The memory, which can store 2048 12-bit words, is designed as a cassette which is capable of being quickly and easily changed. The logger was tested for its dependence on temperature and voltage. The temperature

drift, as calculated on the stored value, is 0.116 mV/°C in the range -40° to +20°C. Resolution power is 1.22 mV. Voltage variations in the battery pack are negligible, provided that the voltage level is sufficient. A small circuit shuts down the logger if the voltage becomes too low. The power consumption is 800 mW when idling. During the storage of data the power demand is increased by 0.34 W for every unit of data, and the write-in time for each unit of data is 32 ms. During one data collection of 2048 units distributed over 2 hours the total power demand is 1.8 Wh (corresponding to a battery output of 0.04 Ah). Collection can be made from eight channels (0-5V) with a data storage interval from 1 second to 99 hours.

- (133) FOA report C40114-C2
Sampling of chemical warfare agents in air and water
Kurt Andersson and others May 1980

A new adsorbent, Amberlite^R XAD-2 has been produced as a suitable substitute for activated charcoal in the type 71 sampling tube for analysing chemical warfare agents in the air. The experiments involved analyses of sarin, soman, FX and mustard gas. The adsorbent gives a satisfactorily high desorption yield for these substances, even after 12 days storage in the dark.

The adsorbent permits the analysis of these chemical warfare agents down to a minimum content ratio of about 0.5 mg/m³ air.

A sampling tube with this adsorbent and the 02 suction pump can also be used for analysing sarin, soman and FX in water in quantities from about 1 µg/l.

- (134) FOA report C40124-C2 (B2)
Transducer to measure gas concentrations by ultra-sonics
Göran Olofsson and Lars Hedlund October 1980

A transducer has been developed for measuring gas concentrations by means of ultra-sonics. The transducer, which measures the speed of sound through a gas mixture, was developed principally for the firefighting gas Halon 1301 (CBrF₃) in air. It is not specific to one gas, but also operates for other gases, though its sensitivity is different. The factors which affect its usefulness are firstly the physical properties of the gas such as density and the relevant molecular structure in terms of gaseous behaviour, and secondly the desired degree of sensitivity. Facilities for monitoring pressure and temperature are desirable for certain measurements.

- (135) FOA report C40130-C2
FORTRAN program for measurement with an ellipsometer
Stefan Sollander and Göran Olofsson February 1981

The report describes a computer program used for processing measurements from an ellipsometer. The program computes the refractive index or the thickness of thin mono- or multi-layer films. The program is written in Fortran and is adapted to the ellipsometer at FOA 4 (Rudolph Research 43603) and Digital's VAX/VMS system. It is a modified version of a program published by Frank MacCracking¹.

C3 Injuries and treatment - chemical

- (136) FOA report C40111-C3, H2, C2
Final report on the project for tissue-culture cells from the nervous system as a system of testing for toxic substances
Erik Walum and Edith Heilbronn April 1980

The toxicity of a number of substances which are of interest in connection with industrial safety was tested in cell cultures of neuronal origin. We have found that the lines of cells neuroblastoma 41A₃ and glioma 138MG constitute good models for cytotoxicological investigations, and that a general correlation exists between the acute toxicity of the test substances in culture and in vivo. The results also indicate that both lines of cells can be used for studying the mechanism of action at the cellular level.

(137) FOA report C40119-C3 (C1)

The effect of anti-cholinesterase antibodies on the enzyme activity and phosphorylation of acetylcholinesterase from *Torpedo marmorata*
Ingemar Jonsson and others

July 1980

The purpose of this research was to study whether antibodies against acetylcholinesterase have any protective effect in cases of nerve-gas poisoning. It was also investigated whether antibodies increase the reactivation ability of the phosphorylated enzyme, or whether they hinder or delay its ageing.

Two forms of acetylcholinesterase were purified from *Torpedo marmorata*: one with a low specific activity (salt-extracted enzyme, SChE) and one with a high activity (toluene-extracted enzyme, TChE). Antibodies against each form of enzyme were induced into rabbits and purified. We examined the effect of these antibodies in vitro on the activity of either form of acetylcholinesterase. Antibodies against the salt-extracted enzyme (anti-SChE) were found to have an inhibiting effect on acetylcholinesterase, while those against the toluene-extracted enzyme (anti-TChE) did not inhibit the enzyme.

The enzyme was fractioned into 18S and 10-14S oligomers, with its activity retained. Studies were performed of these oligomers in a complex with antibodies. Among other things it was noted that the substrate concentration for maximum enzyme activity for all oligomers in the complex with anti-TChE was just twice as high as for the free enzyme.

Studies were made of the salt-extracted enzyme in complex with antibodies for its rate of phosphorylation, the enzyme being phosphorylated with sarin or di-isopropoxyphosphoryl fluoride. The halving time ($t_{1/2}$) of the activity for the complex SChE anti-SChE was reduced by a factor of 2.7, and for SChE anti-TChE by a factor of 6.6 when phosphorylated with sarin. When phosphorylated with di-isopropoxyphosphoryl fluoride, the reduction of $t_{1/2}$ compared with the free enzyme was respectively 2.7 and 16.5 times.

Compared with the free phosphorylated enzyme, the reactivation ability was twice as great for the complex SChE anti-TChE, whereas no change was noted for the complex SChE anti-SChE.

The LD₅₀ doses for sarin and soman were measured in vivo on mice immunised with SChE and TChE respectively. The mice were injected prophylactically with 5 mg toxogonin and 20 mg atropine per kilogram body weight before administration of the nerve gas. For animals with antibodies against TChE the LD₅₀ value did not change, while for those with anti-SChE a doubling of the value was obtained.

- (138) FOA report C40123 (C3)
Development of the radio-enzyme method for determining choline and acetylcholine
Karin Nilsson October 1980

Acetylcholine and choline in the same biological sample can be determined by the radio-enzyme analysis technique as a modification of Massarelli *et al* (1976) and Eckernäs and Aquilonius (1977). The concentration of choline was obtained from the unhydrolysed sample, and that of acetylcholine between hydrolysed and unhydrolysed samples [sic]. Acetylcholine hydrolyses to choline in the presence of NH_4OH /methanol. Choline and acetylcholine are extracted with tetraphenyl boron. After the extractions about 80% of the original choline is recovered. Acetylcholine is stable during extraction.

The method of determination is based on acetylation of the total choline content in the sample with ^{14}C -acetyl CoA in the presence of cholinacetyltransferase (ChAT). Both commercial ChAT produced from ox brain (sigma) and ChAT purified from rat brain (Massarelli *et al*, 1976) were used for this reaction. The commercial enzyme exhibits a somewhat lower sensitivity (about 25 pmol) compared with that produced from rat's brain (10 pmol). The standard curve was linear up to 500 pmol choline. Known concentrations of acetylcholine up to 500 pmol could be determined with certainty. By this method the choline concentration in rat cortex was 14 nmol/g wet weight, while that of acetylcholine was 12.5 nmol/g wet weight.

D AMMUNITION AND WEAPON TECHNOLOGY

D1 Technology of explosives

- (139) FOA report C20393 (D1)
Testing of a work bench for handling explosives in laboratories
Rune Hank and others January 1981

At the FOA, Branch 14 has produced a prototype workbench for handling explosives in the laboratory. It is intended to enable work to be done with up to 10 g of detonating explosive or 50 g of deflagrating explosive. At the request of the Industrial Safety Fund this prototype has been tested to see the consequences which might result from accidental initiation during work at the bench. The tests performed demonstrate that, after some modification, the workbench should in most cases considerably limit the injury which an operator might incur through an accidental initiation.

- (140) FOA report C20395 (D1)
Fuel-rich propellant with ammonium perchlorate as the oxidiser and mixtures of HTPB and polystyrene as the fuel
Torsten Liljegren February 1981

Fuel-rich HTPB propellant has been investigated by test-firing it in a rocket motor. An earlier report on a propellant with HTPB alone as the fuel has been supplemented by examining a propellant having n-butyl ferrocene as the combustion catalyst. This gave a higher rate of combustion than iron oxide, and the content of perchlorate could be reduced to 25% while continuing to produce stable combustion.

The report deals mainly with propellant with HTPB and polystyrene (PS) as the fuel, the polystyrene being in granular form with grain size 100-300 μm and being used in a high proportion. This propellant has some good properties. Its density and hence its thrust per unit volume are somewhat greater than for the corresponding pure HTPB

propellant. It also has a higher rate of combustion, provided that fine-grained ammonium perchlorate and an efficient combustion catalyst (alkyl ferrocene) are used, and that the ratio PS:HTPB is greater than 1:1. Particularly high combustion rates have been obtained with extra-fine ammonium perchlorate, *eg* 30 mm/s at 10 MPa for propellant containing 30% AP. HTPB propellants with polystyrene as a rule produce fewer sooty residues on combustion than a pure HTPB propellant.

- (141) FOA report C20401-D1
Trotyl. A study of the literature, 2
Jan Hansson and Göran Åqvist March 1981

The report is a compilation of information and references concerning trotyl in Beilsteins Handbuch der organischen Chemie, drittes Ergänzungswerk, and Chemical Abstracts 1961-78.

D3 Rocket engine technology and associated ballistics

- (142) FOA report C20394-D3
Computerised measurement system in FOA Branch 27. Measuring instruments and their functions
Sven Wahlström and Bertil Sandberg February 1981

The introduction of a computer-controlled collection system for measurement data in Branch 27 was the occasion for equipping and supplementing the analogue instrumentation for generating and matching measurement signals to the digital system.

A description of the functions of the various instruments and their mode of operation together with experience gained from a period of working with the system is submitted in the present report.

The report is also intended to constitute documentation on the instrumentation and measuring techniques at present being followed in Branch 27.

D8 System studies

- (143) FOA report C20397-D8 (F8)
Geographical data-processing in West Germany
Anders Wellving February 1981

The report contains the results and experiences from a study visit paid by the author to West Germany in November 1980. It attempts to give a summary description of development and applications of geographical data-processing in that country. It reports that heavy investment has been made in equipment and computer programming for the automatic production of topographical maps for both civil and military purposes. The interest in computer techniques is also very high in connection with specialised mapping for various applications, and one problem is felt to be the lack of training facilities in this field. Activities at the following locations are described in greater detail: computer centres in Schleswig-Holstein, Kiel-Altenholtz, the Institute of Military Geography in Bonn and the Institute of Applied Geodetics in Frankfurt. A detailed review of the programming system for geographical data-processing is included as an appendix.

- (144) FOA report C20398-D8
A study of the cost-effectiveness and the parameters of feasible Swedish systems of anti-tank warfare (pilot study using the KVALOPS model)
Börje Aulin and others March 1981

The report gives comparisons of fire-power measurement in terms of losses to the enemy and own troops, obtained by simulation by the *KVALOPS* model of the deployment of feasible Swedish defence systems against attacking mechanised formations. The study, which extends only to delaying actions in open country with favourable visibility, covers medium tanks, light SP artillery, vehicle mounted anti-tank missile launchers, pvhkp (hand operated anti-tank weapons), fighter aircraft and different types of terminally guided ammunition for howitzers and mortars.

The report also contains an analysis of the effect of the main parameters of these systems on the outcome of the engagement.

The results are intended to be regarded only as an illustration of some theoretically possible applications of *KVALOPS* and some typical forms of output data.

It is intended shortly to continue this work with a more comprehensive study covering a wider range of techniques, combat areas and costs.

E CONDUCT OF WAR - INFORMATION AND COMMAND TECHNIQUE

- (145) FOA report C30210-E
New methods of generation and amplification of micro- and millimetre waves in vacuum tubes (in English)
Herbert Steyskal January 1981

The report describes the physical principles underlying new vacuum tubes such as the gyrotron, peniotron, free electron laser and maser, orotron and gyrocon. These tubes, designed for very high frequencies and/or very high power, differ considerably from the conventional microwave tubes. They are still at the research and development stage, though they may become important for fusion and radar techniques.

E1 Reconnaissance, target location and fire control

- (146) FOA report B30038-E1
Block-iterative methods for consistent and inconsistent linear equations (in English)
Tommy Elving

The article describes computing methods for large systems of linear equations, based on a decomposition technique. The systems are either over- or under-determined, and are solved in terms of least squares. Decomposition may be performed in two ways: by a breakdown of the solution vector or by a breakdown of the right-hand term in the equations. The resulting secondary system is solved and the results are collected into a large iteration stage. Proof of convergence is based on the theory of generalised inverses and orthogonal projections. The problem of performing image-reconstruction from X-ray projections is discussed as one application.

Offprint from Numer. Math. (1980) 35, pp 1-12

FOA reprints 1980/81:23.

- (147) FOA report B30039-E1
Computer densitometry of retinal nerve fibre atrophy. A pilot study (in English)
M. Lundström and J-O Eklundh

Low opacity in the nerve fibre sheath and granularity are important signs of optical atrophy in the retina. In this pilot study a series of fundus photographs from a developing case of optical atrophy is examined by computer densitometry. During the

development it was possible to identify a monotonic increase in the local density. It is possible by this method to detect and quantify diffuse atrophy in the layer of nerve fibres in the retina.

Offprint from Acta Ophthalmologica (1980), 58, 639-644,
FOA reprints 1980/81:24.

- (148) FOA report B30040-E1
A relaxation method for multispectral pixel classification (in English)
J-O Eklundh and others

Three methods are compared for reducing errors in multispectral pixel classification: (1) after-processing (iterative re-classification based on comparisons with the classification of adjacent elements); (2) pre-processing (iterative smoothing by averaging-out over a selected number of adjacent elements before classification); (3) relaxation (a probabilistic classification followed by iterative adjustment of the probabilities). Relaxation methods yielded clearly superior results in experiments with colour pictures; relaxation eliminated from 4-8 times as many errors as the other methods.

Offprint from IEEE Transactions on Pattern Analysis and Machine,
Intelligence (1980), PAMI-2, 1, 72-75,
FOA reprints 1980/81:25.

- (149) FOA report B30041-E1
Some relaxation experiments using triples of pixels (in English)
J-O Eklundh and A. Rosenfeld

Relaxation methods for pixel classification and sharpness enhancement usually deal with the eight adjacent elements to each point independently, and form the average of their several contributions. Triples of pixels are used in this study. Particular attention is paid to a point and its pair of adjacent neighbours. For the classification of colour pictures this produced results which are comparable with those usually obtained, while the results of experiments in sharpness enhancement were better than the corresponding results with conventional methods. It is therefore felt that the improvement does not justify the increased costs of computation.

Offprint from IEEE Transactions on Systems, Man and Cybernetics (1980),
SMC-10, 3, 150-153,
FOA reprints 1980/81:26.

- (150) FOA report B30042-E1
FOA 3 contributions at the 1st Scandinavian Conference on Image Analysis,
Linköping 14-16 January 1980 (in English)

Noise suppression in images based on coupling between neighbouring cells;
iterative image-restoration using decomposition techniques; possible improvement in digital image-restoration; the image-processing system at FOA; presentation of grey-scale information via binary media; a programming system for effective multispectral classification; automatic detection of swarf on the workpiece; some algorithms for programmable seeing systems on automatic assembly lines; perception of noise and definition in degraded images; subjective measures of image quality; perceived properties of channel noise in image transmission.

Offprint from FOA 3 contributions at the 1st Scandinavian Conference on Image Analysis, Linköping 14-16 January 1980, pp 64-378,
FOA reprints 1980/81:27.

- (151) FOA report B30043-E1 (in English)
Computer processing of multilayer imagery data
T. Orhaug and others

Technical aids and methods of computerised image processing have become an important tool for the handling, processing and analysis of multispectral image data from airborne and satellite-borne sensors. This article describes the background for such data-processing and various mathematical operations which are being employed. The main object of this study is to describe a programming system by means of which various functions of processing and analysis can be performed. An interesting feature of the programming system are the algorithms for classification by pixels (with a learning facility) of multi-layer data. This classification is performed in a linear-transformed domain, and the algorithm results in a CPU time which is a linear function of the number of layers (compared with a square-law function for the classical implementation of maximum-likelihood classification by Bayes' theorem).

Some examples are given of pilot and applied studies in environmental conservation and land use. Forest mapping in Sweden is regarded as an important problem for application, and the article describes some examples to demonstrate the importance of using non-spectral information in order to achieve an improved accuracy of classification in the detection of clearings in forest land.

Offprint from the Radio and Electronic Engineer (1980), 50, 11/12, pp 575-584,
FOA reprints 1980/81:29.

- (152) FOA report C30208-E1
Description of a radiometer for 94 GHz
Rolf Krook and others December 1980

At the request of FOA 3 a radiometer for 94 GHz has been developed at the Department of Electronic Physics I at Chalmers Technical College, Göteborg. This report describes the construction and operation of the radiometer. Sub-units of the radiometer designed and developed at Chalmers include the mechanical modulator and the hot and cold temperature references with their associated control units. The radiometer is a Dicke receiver and its operating temperature was measured at 876°K with double sideband.

- (153) FOA report C30212-E1 (T3)
Computer simulation of satellite imagery (in English)
T. Orhaug and G. Forsell January 1981

The report describes a small pilot project the object of which is to simulate by computer methods photographic images having properties similar to those taken from satellite-borne sensors. The initial data for the simulation are an air reconnaissance photograph with an effective IFOV of about 10 cm. By performing linear filtering on the computer a series of new image data can then be generated, all of which have poorer resolution than the original. An IFOV is chosen in the simulation so as to correspond with the resolution of image sensors for various civil and military satellite systems.

Then, starting with the new image data, an estimate is made of the size of the targets which can be detected and identified with different levels of image resolution.

- (154) FOA report C30215-E1
Annual report 1980 (in English)
Department of Information-processing FOA 32, and Department 53 Psychology for
Information Systems January 1981

The report provides a comprehensive description of activities in information-processing and psychology for information systems during the 1980 calendar year.

- (155) FOA report C30216-E1
Two-colour TV sensor with encoded colour presentation
Carl Hugo Ågren March 1981

The report describes a two-colour TV system built from commercial TV components for real-time observation with encoded colour presentation (false colour). The general principles for this type of observation are discussed. The construction of the TV system is described together with problems and operating experience. The technique has been applied to the observation of artificially green-coloured objects against a background of vegetation. The report covers the results obtained and indicates some likely applications.

E2 Communications

- (156) FOA report C30211-E2
Measurement of light absorption in seawater
B. Kleman and S. Palmgren January 1981

The report describes various attenuation effects in the propagation of optical radiation under water. Some theoretical methods are stated for determining attenuation constants. The experimental attenuation data as reported in the literature are analysed with the object of obtaining some idea of the way in which the absorption constant a varies in different waters. A summary is given of the existing theories on the propagation of optical radiation in water. A breakdown by type is made of the different measuring instruments used for radiation measurement under water. Some designs of absorption meter are presented. The size of the measuring error in determining the absorption constant a is discussed.

This article forms part of the FOA/STU agreement on marine technology.

E4 Countermeasures, including signal interception and technical intelligence

- (157) FOA report A30023-E4
Broadband radars - principles and possibilities of jamming
Per Hyberg December 1980

The report constitutes a summary of published, and in recent years increasingly abundant literature on broadband radars and countermeasures against them.

The aim of the article is to list both different radar applications of broadbanding and also the theoretical possibilities which are available for the effective deployment of countermeasures against these applications.

The report sets out several limitations of theoretical and other kinds which affect broadband techniques, and it also indicates the new demands made by these techniques on intercept receivers and jammers.

- (158) FOA report C20400-E4
 ROK - an interactive computer program for optical transmission through smoke.
 Description of routines for computations and for graphic presentation of level curves
 Lars Björklund and others March 1981

ROK is an interactive program for computing optical transmission through a cloud of smoke. It enables the user, mainly through the command code, to study the effects of various parametric values. The program is thus able to describe a smoke cloud during its propagation and diffusion stages, wind layers and moving targets. At chosen times the results are shown either as values on a given lattice or graphically as level curves, the user being able to choose between two methods and successively search for areas of interest. The report includes a physical background, the mathematical expressions, a detailed description of the ROK program and a worked example.

- (159) FOA report C30209-E4
 A broadband AM link
 Anders Käll Dahl December 1980

The report describes the construction of an AM demodulator for broadband modulation signals. It also deals with the problems arising during efforts to get the design to satisfy the requirements. The result was that the design exhibits an input dynamic range of 45 dB with a signal/noise ratio of more than 20 dB regardless of position on the dynamic curve. The components used were chosen so as to make the demodulator as cheap as possible.

F VEHICULAR AND SPACECRAFT TECHNOLOGY

F9 Materials

- (160) FOA report B20029-F9
 The microstructure of hot press sintered boron carbide of various composition
 Lars Ekbohm and Carl-Olof Amundin (in English)

It was shown in a previous report that an increased boron content in boron carbide assists the sintering operation and improves its mechanical properties. Continued investigations have shown that diffusion and therefore sintering also are the optimum for a composition of about $B_{13}C_2$. In contrast to the investigations into the structure of boron carbide performed by the CVD technique, sintered boron carbide exhibited a continuous solubility for carbon from 10-20 atoms per cent. This is assumed to be caused by supercooling of the state in high-temperature sintering. Electron and ion microprobes were used to determine the distribution of various substances in the microstructure. Nitrogen can be an impurity which limits the growth of grains.

Offprint from Science of Ceramics (1980), 10, 303-310,
 FOA reprints 1980/81:33.

- (161) FOA report C20396-F9
 Kevlar 49 fibre composites in sandwich facings (in English)
 Fritz Larsson February 1981

The mechanical properties of honeycomb panels with a self-cured outer layer of Kevlar 49 fibre composites were studied and compared with panels with an outer layer of E-glass and S-glass fibre reinforcement. The high specific bending resistance of Kevlar 49 composites is reflected in an initial stiffness of the panels which is greater

than that in panels with an outer layer of E-glass or S-glass fibre composites for the same weight of the outer layer. On the same basis of comparison the load per unit width when the panel ruptures with a Kevlar 49 reinforced outer layer is nearly comparable with the load on the outer layer with E-glass reinforcement. The toughness of Kevlar 49 fibre can be observed in the surface of fracture of the outer layer.

H HUMAN ENVIRONMENT

H1 Investigations, future projections

(162) FOA report C55047-H1

Development of the will to defend from ages 14-18. An interview study
Lennart Sjöberg and Åsa Boholm March 1981

Attitudes to defence, defensive operations and the community in Sweden were studied by means of interviews with three groups of boys aged 14, 16 and 18 years. The interviews were summarised and coded, after which the coded variables were statistically analysed. The material revealed a trend implying that the 14 year olds had the most positive attitude towards the community and to defence and their own future. The higher ages were successively developing more negative opinions and a greater degree of pessimism, though not necessarily a weaker will to fight. The 16 year old group in this material also exhibited a greater amount of political radicalism than the other two groups. The parents' attitude to defence and their political sympathies varied in keeping with the attitudes and opinions of the young people.

H2 Hostile environments, closed units, field hygiene

(163) FOA report B54021-H2

Production of fresh water and purification of water from the Swedish coast at the Baltic Sea and the North Sea (in English)
G. Lindner and G. Nilsson

The report describes experiments on reverse osmosis, otherwise termed hyperfiltration; some of these experiments were performed using onshore equipment, and others in a submarine. In addition some earlier investigations are reported which were made during the 1970s.

The modules employed were:

Ajax Corporation spiral module; Plate and frame DDS modules; Dow hollow fibre modules; Du Pont hollow fibre modules; and Paterson & Candy tube spaghetti membrane.

The tube membrane was mostly used and afforded good results. The necessity for aerating the raw water before filtering out the iron, and also for monitoring the quality of the raw water at all times, is emphasised.

Offprint from Proceedings of the 7th International Symposium on Fresh Water from the Sea (1980), 2, pp 267-277,

FOA reprints 1980/81:16.

(164) FOA report B54023-H2

The respiratory response to microwaves (in English)
C.O. Criborn and C-J Clemedson

Male mice were exposed to microwaves at 2450 MHz, with an intensity of 1, 10 and 100 mw/cm² and a dose of 300 mw min/cm². Thermal effects were produced by 100 mw/cm² for 3 min. Rectal temperature rose by 2° and the respiratory volume per minute fell

during the first 2 min. It then increased rapidly and fluctuated until irradiation was discontinued, after which the volume per minute fell to a value which was lower than normal.

A new method was employed for studying the effect on the nervous system by means of sonic pulses, which affect the respiratory volume per minute, an acoustic reaction. This reaction deteriorates at the same moment as exposure begins and returns to the normal value a few minutes after irradiation is stopped. During exposure at 10 mw/cm^2 over 30 min both the acoustic reaction and the volume per minute are reduced. Rectal temperature is unaffected. 1 mw/cm^2 over 300 min affects neither the volume per minute nor the rectal temperature, but it reduces the acoustic reaction 4-5 h after the start of irradiation. From the experiments performed it is possible to evaluate the effect of heat and heat regulation by respiration and rectal temperature. The effect on the conditioned acoustic reaction shows that the nervous system is involved regardless of the heat developed and the process of thermal control during and after exposure to microwaves at 2450 MHz and intensities of 1, 10 and 100 mw/cm^2 .

Offprint from Aviat. Space Environ. Med. (1980), 51(10), pp1139-1143,
FOA reprints 1980/81:28

- (165) FOA report C40127-H2
Aerosols and relative atmospheric humidity. A situation report for Grant Dnr 79/137, Industrial Safety Fund as at 31 December 1980
Mats S. Ahlberg and Jan Bylund December 1980

This report deals with a system for generating humid air and a diffusion drier for drying humid air.

The system was tested with a welding fume aerosol, and a change of shape of the smoke particles from chain-like aggregates to agglomerates of spherical appearance on humidification followed by drying was demonstrated by transmission electron microscopy.

H3 Environmental extremes

- (166) FOA report B58011-H3
Vibration and decompression gas bubbles (in English)
U.I. Balldin and A. Sporrang

Muscular activity and also passive movements of the extremities can release gas bubbles from the body tissues to the bloodstream owing to decompression after diving. The purpose of this study was to discover whether vibrations of the type which occur in helicopter flights can also produce a similar release of gas bubbles.

Test subjects were exposed to simulated dives to 250 kPa for 100 min in a pressurised chamber, while at the same time performing intermittent muscular activity. Diving permits what is known as direct ascent. Decompression to the ground-level equivalent is followed by decompression in a low-pressure chamber to 70 kPa. Experience has shown that these exposures give rise to a considerable development of intracardial gas bubbles. Gas bubbles in the bloodstream were recorded by the precordial Doppler ultrasound technique. The ten subjects were exposed for 15 min periods to vibrations at 15 Hz and $0.23 g_z$ of the type which may occur in a single-rotor helicopter, alternating with 15 min vibration-free periods. Vibrations at 25 Hz $0.64 g_z$ (ie the type of vibrations which can occur in twin-rotor helicopters) were also studied in some individual cases.

No significant difference in the liberation of gas bubbles could be recorded between the periods of 15 Hz vibration and the vibration-free periods. The quantity of bubbles is thought to be independent of whether vibrations are present or not. Further investigations may show whether different frequencies, amplitudes or directions of the vibrations may have the effect of releasing bubbles.

Offprint from The Physiologist (1980), 23, Suppl, p 147-148,
FOA reprints 1980/81:30.

H5 Emergency treatment, rehabilitation, preventive medicine

(167) FOA report C50002-H5

The Swedish civil population in wartime - physical illnesses and handicaps of importance for confinement in shelters

Lars Carling (Bollnäs Casualty Station) and Henry Lorin

The report gives an account of actual physical illnesses, injuries and handicaps which may affect the ability of the public to use shelters.

It appears that the number of people with this type of problem is large - probably almost a quarter of a million. One contributory factor is that a great many people are now capable of reaching a ripe old age. Senility, injuries due to wearing-out, a condition of rest after serious illness and physical injury etc mean that it is very often difficult for people to make for a shelter and remain there for lengthy periods. Many cases exist which require long-term medical treatment.

This report makes no recommendations as to how these 'problem cases' should be suitably handled. This will require continued study and discussion.

H6 Individual and group efficiency

(168) FOA report C55046-H6

Small group decision making - a survey of literature
Roger Hagafors

(in English)
February 1981

This report is a review of the literature on accumulated research activities on the subject of decision-making in small groups. It is introduced by giving the frame of reference for the review. A systems approach is recommended, in which the group is regarded as a subsystem in an organisation. The concept of decision-making is defined from a functionalist standpoint, namely that all activities which are intended to result finally in a decision are considered to be decision-making activities. A classification of decision-making activities is also introduced, which is based on the organisational purpose of the particular group activity.

The review covers an account of results gained from individual-group comparisons with respect to performance in tasks of judgment and problem, solving, and also an account of experiments in improving group performance in decision-making by means of aids and training. It also deals with group interactions in different decision-making situations: integration of information, integration of values and the justification of decisions. Two different approaches are also reported for describing group interaction.

The conclusions are briefly that the comprehensive research concerning group behaviour has contributed only a little to our knowledge of decision-making in small groups. The reasons for this appear to be chiefly that there was no specific description of the problem and that the interest was centred more on finding 'phenomena' than on acquiring specific knowledge of group behaviour in defined situations.

The frame of reference set out in this report has proved to be useful for analysing earlier research activity, as well as for generating problems for future research work.

H9 Man and machine systems

- (169) FOA report C53003-H9 (in English)
 Colour coding of displays, maps and images February 1981
 Gunilla Derefeldt

The present report presents the literature on colour coding of visual displays, maps and images. The report discusses colour coding from a psychological standpoint, as a potential aid to improving visual performance in detection, search, identification, classification and interpretation.

Preference gradings show that people prefer colour-coded to plain presentations. Provided that the colour-coding is matched to the function, it can be generally said that colour-coding constitutes an effective aid. When used as a redundant code, colour is always effective. For identification tasks and symbol displays however, letter and figure codes are recommended rather than colour. It should be noted that colour-coded symbols tend to interfere both with the search and identification of non-coloured targets.

- (170) FOA report C56025-H9 (M6)
 Group communication via computer: introductory soci-psychological studies of the KOM system at FOA; a summary
 Lillemor Adrianson and Lennart Sjoberg December 1980

Computerised telecommunication systems are expected to become very important in the future. These systems have existed and been used internationally for about 10 years. The Institute of Defence Research (FOA) intends shortly to introduce a computerised teleconference system which is one of the first of its kind in Sweden. The use of such systems is expected to be very important in decentralising the activities of various authorities and organisations.

This summary is based on two reports (FOA 5 reports C56023-H9 (M3) and C56024-H9 (M3)) and on socio-psychological research on the KOM system at FOA, and it covers 2 years' investigation into the use of KOM.

M INTERDISCIPLINARY STUDIES AND INVESTIGATIONS

M3 Security aspects of environmental studies

- (171) FOA report A10002-M3
 The doctrines, principles and assumptions of the Great Powers for coastal invasions
 Folke von Celsing January 1981

The object of the present study is to take a general look at the probable principles, assumptions and trends concerning coastal invasions. The study considers that ABC weapons will not be resorted to immediately. Should this occur however, the assumptions would be quite different from the case if only a threat from conventional weapons were to exist. The ABC threat is separately discussed in broad terms elsewhere in the study.

The theoretical attitude of the Great Powers to coastal invasion is felt to be positive - if an invasion is called for, they are probably prepared to mount one, at

least to a limited extent. The Great Powers and also certain minor maritime nations are also partly ready for this.

The study pinpoints the fundamental importance of air superiority for any coastal invasion. The difficulty of achieving this in invasions against defended areas is presumably due to the increasing missile threat, but also to a general lack of aircraft carriers. The study also considers that large paratroop operations will be involved in any invasion, which makes it particularly necessary to possess definite air superiority.

Softening-up and strong fire support were important factors in WW II invasions, and considerable resources were earmarked for this. The study finds however that the resources of even the Great Powers in this respect have run down considerably since the war and seem likely to become still fewer, so that for this reason as well an invasion against a strongly defended coast may appear doubtful.

Most navies at present possess special tonnage for beach landings as a general rule, though only to a quite limited extent. The USA, USSR and China are dominant in this field, but even the total capacity of the USN is sufficient for transporting only about one division at a time. If heavier invasions are required commercial shipping would have to be used even from the first sailings. Modern merchant shipping however, eg ro-ro vessels, is quite suitable for amphibious operations. Helicopters and amphibious vehicles are among the most important means of transport in an invasion area, since they afford greater possibilities of maintaining high speeds and achieving greater depth in the invasion.

Missiles, mines and communications jamming measures are considered to be the most serious conventional threat to a coastal invasion. Comprehensive protective measures, including requirements for an extensive protected zone comprising both air and communications superiority around the amphibious forces and the invasion area are always necessary. Technical advances however mean that it is becoming increasingly difficult to create such a zone.

Maritime locations worldwide would be the first to be exposed to an invasion threat in the event of an outbreak of hostilities. The object of the Western Powers therefore is probably to strengthen rapidly their oceanwide positions including the encirclement of the communist countries, while the object of the USSR in particular would be to disrupt any such encirclement, partly in order to be able to threaten ocean shipping.

(172) FOA report B10133-M3
 Future studies and national security: the Swedish experience
 Nils Andrén (in English)

The article deals with the development of studies in security policy and their role in the long-term planning of Swedish defence. Two principal trends can be distinguished. One of them is to outline the long-term future prospects, based on research, in the form of 'alternative futures'. The second is to devise particular cases of crisis or attack. The study of future security policy is also regarded as a scientific activity pursued in an environment characterised not only by more or less well-defined and

articulated political objectives and preconceived opinions, but also by the requirements of the administrative process and institutional preferences.

Offprint from Cooperation and Conflict (1981), 16, pp 39-56,

FOA reprints 1980/81:32

(173) FOA report C10169-M3
The Palestine Conflict and the 1980s
Sune Persson

October 1980

This study predicts that the peace treaty between Egypt and Israel will be completed in 1982 by a total Israeli withdrawal from the Sinai Peninsula and the normalisation of Egypt's relations with Israel. Probably as a result of American pressure Israel will be forced to accept a long-term Palestinian autonomy on the West Bank, including the Arab sections of Jerusalem and in the Gaza Strip. After 5 years' autonomy in these areas a Palestinian state will be declared, controlled by representatives of the PLO. By that time the state of Israel and the PLO will have recognised each other. The Palestinian state however will then be united constitutionally with the Hashemite Kingdom of Jordan and will develop into a relatively conservative and western-oriented state.

This is essentially an optimistic forecast. It is perhaps no coincidence that the most attractive alternative for Sweden and the Western World of the three scenarios under discussion, *ie* the peace alternative, is also felt to be the most likely. The grounds for the optimism are premises which may turn out to be untenable

One such premise is that the trends of the 1970s will continue broadly unchanged. One break in the trend which is thought to be fairly likely however is that Israel will become in the 1980s the first nuclear power in the region. This will lead to an 'imbalance of terror' in the region, where the Arab states will probably *not* acquire their own nuclear weapons. As a nuclear power Israel will be able to deter the Arab States from any new *large* conflict with Israel, but there is a fear that she will also apply her 'power of veto' to such an irreconcilable nationalistic policy against the Arab World, and particularly the Palestinians, as to preclude any durable peace settlement between the Israelis and the Arabs.

Another premise is that developments during the 1980s will be controlled by rational decision-makers who desire peace in the region. Should the decision-makers be incapable of controlling developments or should they be irrational, the process of escalation may lead to a new and destructive major Arab-Israeli war. The possibility also cannot totally be excluded that the Arabs will continue to refuse to accept the state of Israel, and that they are continuing to plan a decisive war to demolish the Jewish state, and that Arab 'moderation' of the 1970s will be seen as a tactical phase when Israel was militarily superior. Similarly it may be questioned whether the Israeli leaders yield priority to peace over the occupied areas which are regarded as belonging to *Eretz Israel* for religious-historical reasons. A disturbing tendency during the latter part of the 1970s has been the growing influence acquired by religious fundamentalist forces both in the Islamic world and in Israel. Should these forces, as personified by Ayatollah Khomeini in Iran and Prime Minister Begin in Israel come to dominate the Arab world and Israel in the 1980s, then the chances for a solution to the Palestine problem will be

minimal. A compromise solution of this calls for secularised and politically 'moderate' leaders on both sides in the Arab-Israeli conflict.

A similar factor of uncertainty is the objective of the Soviet Union in the Middle East. Here opinion has been that the Soviet Union must be a partner in any all-round solution of the Palestine conflict. However if the Soviet Union has expansionist intentions in the region then logically the Soviet leaders will not contribute to promoting a peaceful solution, but instead will use their influence in Syria and over the PLO in order to undermine the American-orchestrated peace process.

This study forms part of the 'AIS Project'.

- (174) FOA report C10173-M3
Eurocommunism and the East-West Relations (in English)
December 1980

The object of this study is to discuss the effect of Eurocommunism on east-west relations. Three subjects are specially dealt with: Eurocommunism as a destabilising factor in Eastern Europe, in Western Europe and its effect on the Western alliance.

This study forms part of the 'Eastern Project'.

- (175) FOA report C10174-M3
Review of research into security policy for overall defence
Lennart Johansson February 1981

The Government's efforts to limit public spending mean that the FOA should also investigate the consequences of reduced appropriations for its own activities. A proposal to review research into security policy has been submitted for future planning in the FOA. In this context a working group has been set up charged with describing the consequences of any reduction in appropriations for research and study activity into security policy. The enquiry group has primarily attempted to provide for the needs of overall defence. If the resources for defence-financed research into security policy are reduced by the order of magnitude discussed in FOA future planning, the group is proposing that the reduction should be mainly at the expense of UI.

It is however desirable on general grounds for an independent and professional research programme into security policy to be pursued in this country, and it is likewise in the public interest for superior education, information and debate on security policies to be encouraged by such research. In so far as research at the UI can no longer be supported by Defence funds, the subject of how this activity should be financed henceforward should therefore be taken up for consideration at the political level.

M4 Systems and program planning

- (176) FOA report C10176-M4
Market forces 2000. The nature of conventional market forces in Central Europe in terms of policy, doctrine, economics and technology
Hugo Wiechel March 1981

The conventional forces which are at present grouped in Central Europe afford to both sides credibility as their ability to deter their opponents from an attack from the present grouping. Regroupings in the east are feasible, which implies that the credibility of the west cannot be sustained by conventional means, and not even perhaps by nuclear weapons.

Since both sides have chosen mainly armoured formations for the execution of military tasks, they can mutually accuse each other of the ability, and probably also the intention, of conducting a war of aggression.

During the next 20 years Europe may decline considerably in economic and political importance, although for the Soviet Union the most dangerous trend remains in military terms. Neither the objectives of security policy, nor the development, of the technologies or economies of the two Pacts should mean that their will and ability to retain and improve the military resources which they have hitherto chosen would be forfeited on either side. Armoured formations would essentially exist in the year 2000 as the main military arm.

Over and above its original purpose the study has formed a basis for the following conclusion. If disarmament negotiations could lead to a ban on armoured vehicles, then the fundamental and sought-for credibility could still be sustained by infantry and artillery. This would deprive both sides not only of their grounds for accusations of the ability and the intention to attack, but also of their grounds for maintaining special nuclear weapons to achieve credibility for the worst cases.

M5 Economic studies

(177) Report SP 1980:1
Future energy systems - multiple objectives - new techniques
Brita Schwartz and Ingemar Lekteus

The study takes a long-term view of the Swedish energy system. Starting with an analysis of the objectives to which importance is attached in Swedish policies and debates on energy, the relation is studied between firstly the various objectives, needs and constraints affecting the long-term development of the Swedish energy system, and secondly the strategies for development, new techniques and R&D effort. The study, initiated by the Delegation for Energy Research (DFE) is partly intended to provide the DFE with a basic contribution for planning its research.

The project has comprised a development and adaptation of the principles of strategic planning (long-range planning) to the energy field, with particular emphasis on the nature of the problem as what is termed a multi-objective problem and on the need for freedom of action as regards the long-term development of the energy sector. In the study which was carried out into applications different scenarios for an energy system were outlined and some concrete examples of the development of the energy system during 1980-2020 were constructed by means of a technical and economic energy model, which was a multi-period linear programming model designated *MARKAL*. The results have been related to a number of long-term strategic energy problems, *eg* the alternatives and the rate of change in replacing oil by other types of energy, the introduction of natural gas, costs and alternative substitutes for power generation as nuclear power is developed, the possibilities of switching principally to domestic power supplies, the clashes among various objectives etc. Starting from the *MARKAL* runs already performed, the final chapter discusses the profitability of different types of new energy technologies under various assumptions.

This report can be ordered from the Reporting Centre, FOA 1.

- (178) FOA report C10175-M5
Factor demand in Swedish manufacturing industry with special reference to the demand for energy (in English)
Kent Rune Sjöhlrm February 1981

Starting from a formula for a costing function, the demand functions for production factors such as labour, capital, energy and other inputs are derived and estimated. Two approximations to the costing function were tested - a translog model and a generalised Leontief model. Proceeding from estimates of the parameters in the functions for factor demand, the elasticities of substitution and price have been calculated. For the production factors in question the choice of approximation for the costing function is thought to be less essential to the result than the restrictions which can be imposed on the parameters or the method which is chosen for representing capital costs.

A special secondary model has also been assessed by the same technique for energy consumption in industry. In this model the energy sources have been separated into solid fuel, motor fuel, heating oil, electricity and miscellaneous (steam, hot water, gas etc). Fuel oil and electricity were found to be substitutes regardless of the choice of model.

M6 Information systems

- (179) FOA report C10159-M6
COM teleconferencing - implementation manual (in English)
Torgny Thölerus and Jacob Palme November 1980

This manual is intended for anyone responsible for installing and operating the computerised communication system COM. This is not a user's handbook.

- (180) FOA report C10163-M6 (H9)
Report on an evaluation of the utility of the COM teleconferencing system
Petter Wikström and others December 1980

The FOA is located at several sites in the Stockholm area and elsewhere such as Linköping, Umeå and Karlstad. This decentralisation has led to expensive and, particularly for staff located outside Stockholm, tiresome travelling. This computerised teleconferencing system COM has been used to permit more extensive contacts without any undue amount of travel.

This report is an account by a group convened by the Director of FOA with the task of evaluating the best means of meeting FOA requirements for textual communication, and the utility of the COM system for this purpose. The group finds that COM has about 230 regular users. Any such user connects himself to COM on average for 20 minutes per working day, writes one communication per working day and reads 22 communications per working day. The system meets a requirement, and cost-benefit calculations indicate certain economic advantages.

- (181) FOA report C10164-M6 (H9)
The COM teleconferencing system functional specification (in English)
Jacob Palme and others November 1980

This document gives a detailed functional specification of a computerised conferencing system. This is based on the COM system for the DEC-10 as it was in operation during the summer of 1979, with the addition of certain functions planned though not yet introduced.

The document specifies an efficient and portable computerised teleconferencing system capable of handling up to 2000 users and conferences. Its orientation to the users has been sufficiently tested to be simple to use by anyone with little acquaintance with computers.

This document was produced at the instance of the international cooperative project COST-11, and constitutes a basis on which to develop a new conferencing system PORTACOM which will be completed in summer 1981.

- (182) FOA report C10172 (M6)
 Uses of the *SIMULA* process concept (in English)
 Jacob Palme February 1981

The class concept in the *SIMULA* programming language is well-known as the origin of what is now termed abstract types of data. A *SIMULA* class however can also function as a process. This article uses several examples to illustrate from existing programmes how this process-aspect within the class aspect can be employed to provide computer programmes with a compact structure. All the examples in the article are derived from actual frequently used production programs, though the examples have been greatly simplified in order to illustrate the most important ideas.

M7 Follow-up and monitoring of scientific research outside FOA

- (183) FOA report C40121-M7
 The POLYTEXT/ARBIT demonstration system (in English)
 Staffan L8f September 1980

This report describes the initial prototype version of the POLYTEXT system, a computer-based system for storing and retrieving textual information. Retrieval in this context denotes the process of locating and presenting those texts or fragments of texts containing information which is relevant to a given requirement. The search is based on a knowledge of the content of the text and not merely on the occurrence of individual words and/or phrases.

The ability of the POLYTEXT system to perform this type of textual retrieval is based on the fact that the text is organised in a communication structure, in which communications are related to one another in a subject/development relation.

In order to illustrate how the idea of a POLYTEXT message can be applied in representing knowledge of a specialised text we have devised three models by means of which information can be retrieved from a legal text. The models are based on: index terms, the hierarchical structure and the predicate structure of the text.

For each operation the necessary grammatical rules have been specified, in order to describe a dialogue with the user, which makes it possible to ask questions in English about the content of the text and to retrieve or to locate those textual fragments which are relevant to a given interrogation.

The reported activity was performed as a cooperative project among the KVAL Institute for Information Science, SRI International and the Swedish Defence Research Institute at Umeå.

T CERTAIN MEASURES FOR LIMITATION AND CONTROL OF ARMAMENTS

T2 Collection and analysis of airborne radioactivity

(184) FOA report C40113-T2 (A1)

The nature of particles in nuclear fallout collected in Sweden from the Chinese test of 18 March 1972

Jan Sisefsky and Rune Arntsing

May 1980

Large quantities of radioactive particles were collected after the Chinese nuclear explosion on 18 March 1972. They were studied by reversal autoradiography and γ spectrography. The report shows how the activity and the nuclide composition vary with the size and colour of the particles. In particular, mass chain 95 is found to vary strongly with colour, so that colourless particles exhibit the greatest content of $^{95}\text{Zr-Nb}$. The β activity of particles, of 0.7 to 3.5 μm , exhibits a mean of 0.19 $\text{Bq}/\mu\text{m}^3$. Studies of fractionation show how much of the various nuclides were incorporated in the hot particles (eg about 80% of material produced in mass chain 95, but only 2% of mass chain 103/Ru/). The content of inactive components in the fireball from construction material is estimated at about 13 kg iron and/or aluminium per kt of explosive force.

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